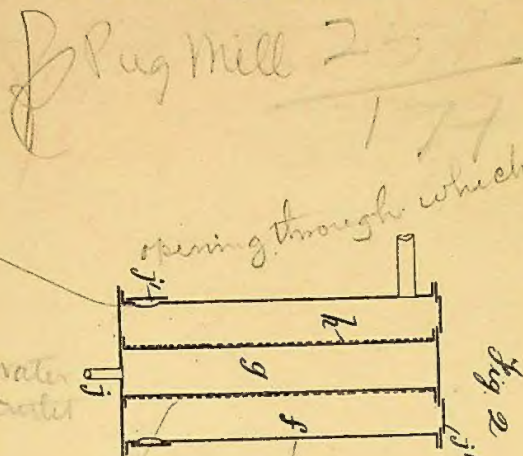


British

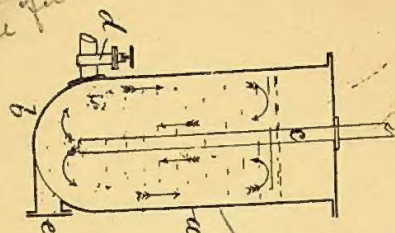
A.D. 1888. Nov. 29. N° 17,363.

HARGREAVES &amp; others' COMPLETE SPECIFICATION.

(1 SHEET)

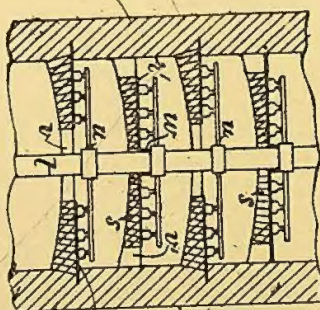
366  
10  
W366  
24dry  
mud  
slurry

opening through which the filtering material is sent  
1889  
closed vessel  
perforated inner vessel  
covered with suitable filter cloth



drying and mud  
1889

dry  
mud  
and  
heating  
slurry



iron shelves  
s. fire clay  
t. central shaft with  
arms w.  
v. circular central openings through shelves q.  
w. lips or rings to prevent the slurry from  
passing through the central openings of the  
shelves q.

filter cloth



Fig. 3

inlet  
outlet  
reciprocating  
blade for cutting  
material

tracing band

[This Drawing is a reproduction of the Original on a reduced scale]



Mixing slurry -

Walter Nicks

11

N° 17,363



A.D. 1888

Date of Application, 29th Nov., 1888

Complete Specification Left, 29th Aug., 1889—Accepted, 23rd Nov., 1889

PROVISIONAL SPECIFICATION.

Improvements in the Manufacture of Cement and in Apparatus Employed therein.

We JAMES HARGREAVES, Chemist, THOMAS ROBINSON, Ironfounder, and JOHN HARGREAVES, Chemist, all of Widnes in the County of Lancaster do hereby declare the nature of this invention to be as follows :—

The object is to improve the manufacture of cement and to provide improved apparatus therefor.

First. To obtain intimate admixture of the materials forming slurry, that is lime, clay and water, we agitate these materials when together by means of aeriform fluid so applied as to give a circular rotating or return motion to the materials. Instead of air we may use carbonic acid or a mixture of gases with or without air as may be required.

lime  
clay  
water

may aerate or  
use carbonic  
acid or gas

Second. Apparatus for carrying the first part of our invention into effect consists of a vessel preferably having a conical bottom provided with aeriform fluid inlets, preferably placed at a sufficient distance from the bottom of the vessel so as to allow the heavy particles in the slurry to settle and admit of convenient withdrawal, and to cause the contents to have rotary motion. Suitable inlet and outlet ways are provided for the slurry and for the separate removal of the settled heavy particles. The vessel is preferably covered and capable of withstanding pressure when required to work in combination with the method of separating water from slurry as described under the following third and fourth heads.

Third. Apparatus for separating water from slurry or materials to be employed in the manufacture of cement so as to partly dry the same, consists of a close vessel or chamber provided with perforated inner vessel or vessels preferably concentric. The inner perforated vessel is covered with suitable filter cloth through which the water is caused to pass by means of pressure applied in the other vessel.

close vessel  
perforated  
inner vessel -  
pressure

Suitable arrangements are provided for taking away the water from the inner vessel and for withdrawing the slurry from which water has been separated.

separate water  
from slurry

Fourth. Apparatus for acting continuously to separate water from slurry or materials employed therefor consists of a perforated tube or vessel preferably taper covered on the inside with filter cloths having an inner protecting screen such as wire gauze. At the smaller end of the tube or vessel is a discharge opening.

The slurry is forced by pressure into the larger end of the tube or vessel. The water passes through the filter cloth and the partly dried materials flow continuously through the discharge opening and are removed from time to time. The outflowing semi-dry materials are by preference automatically formed into bricks or pieces and conveyed by means of an endless metallic band through a heated oven.

formed into  
bricks

Fifth. For drying semi dry slurry or other damp constituents of cement to obtain the same in the form of powder or small pieces we employ apparatus constructed of brick having shelves made of iron or other suitable material. When the material to be dried is in fluid condition we preferably make the sides of iron provided with suitable non conducting material on the exterior to prevent radiation.

In the centre of the chamber is placed a vertical shaft passing through a hole in each shaft. Around the hole in each alternate plate is cast or affixed raised pieces or rings to prevent any fluid slurry or damp materials from falling directly down the chamber without passing over the shelves. Between the shelves we affix to the said shaft arms supporting and causing to rotate suitable scrapers, ploughs or rakes, preferably made of steel fixed rigidly, weighted, or with springs or their equivalents to enable the scrapers, rakes, ploughs, or their equivalents to detach the dried material without danger of breaking the said scrapers.

[Price 8d.]



*Hargreaves, Robinson, & Hargreaves' Improvements in the Manufacture of Cement, &c.*

The slurry enters the apparatus at the top and is constantly moved and allowed to fall from one shelf to another, and in its downward passage meet ascending hot products of combustion. The dried and heated powdery slurry is conveyed preferably whilst hot and by mechanical means to a suitable revolver and roasted into cement. The waste products of combustion from the manufacture of cement are preferably employed 5 for drying the slurry and excess of oxygen is avoided as far as practicable when it is desired to eliminate free Sulphur from the slurry.

Sixth. To rapidly weather—that is to carbonate and hydrate cement—we subject the cement in a finely divided condition to the action of carbonic acid, or carbonic 10 acid and aqueous vapour.

Carbonic acid  
+ aqueous vapor

Seventh. Apparatus for carrying the above treatment (Sixth) into effect consists of a chamber formed of a series of shelves in which by mechanical means the cement is constantly stirred and fresh surfaces exposed as it falls from shelf to shelf to the said carbonic acid or carbonic acid and aqueous vapour. Apparatus of the form described 15 under the fifth head may be used.

Carbonic acid  
+ steam

Dilute carbonic acid such as cool products of combustion mixed with steam or aqueous vapour may be passed through the chamber for the purpose of carbonating and hydrating the cement.

Dated the 27th day of November 1888.

Per pro J. T. KING, 20  
J. Johnson,  
Agent.

#### COMPLETE SPECIFICATION.

##### Improvements in the Manufacture of Cement and in Apparatus 25 Employed therein.

We, JAMES HARGREAVES, Chemist, THOMAS ROBINSON, Ironfounder, and JOHN HARGREAVES, Chemist, all of Widnes in the County of Lancaster, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The object is to improve the method of manufacturing cement and to provide 30 improved apparatus therefor.

First. To obtain intimate admixture of the materials forming slurry, that is lime clay and water; we agitate these materials when together by means of aeriform fluid either air so applied as to give a circular rotating or return motion to the materials or instead of air we may use carbonic acid, or mixture of gases with or without air as 35 may be required.

When air is the aeriform fluid employed such air may be injected by means of any well known pumps or injectors.

Second. Apparatus for carrying the first part of our invention into effect consists of a vessel preferably having a conical bottom, provided with aeriform fluid inlets placed 40 at a sufficient distance from the bottom so as to allow the heavy particles in the slurry to settle and separate from the finer particles, and to admit of convenient withdrawal of such residue through doors or openings at the bottom of the said vessel. The aeriform fluid inlets or pipes are arranged in the vessel so that the injection of the aeriform fluid shall cause the contents to partake of say a circular motion and thus 45 intimately mix the fine particles of lime and clay.

The said apparatus is preferably covered and capable of withstanding considerable pressure when used in combination with the apparatus described under the following third and fourth heads.

Fig. 1 is a vertical section of apparatus under the above second part. *a* is a vessel 50 made with a conical or hemispherical bottom *b* and fitted with an aeriform fluid inlet way *c* leading nearly to the bottom of the vessel, *d* outlet and valve or door for finer particles, *e* outlet and door or valve for coarse particles. The arrows show the direction of motion of the currents.



*Hargreaves, Robinson, & Hargreaves' Improvements in the Manufacture of Cement, &c.*

Third. Apparatus for separating water from slurry or materials to be employed in the manufacture of cement so as to partly dry the same quickly consists of a close vessel or chamber provided with a perforated inner vessel or vessels, preferably concentric, the inner perforated vessel is covered with suitable filter cloth through which the water is caused to pass by means of pressure applied in the outer vessel. A pipe is provided for taking away the water from the inner vessel and the material from which the water has been separated is removed usually dug out of the annular space.

Fig. 2 is a vertical section of apparatus under the above third part. *f* closed vessel or chamber provided with an inner perforated chamber *g*, *h* filter cloth, *i* inlet way for liquid to be filtered, *j* outlet way for water, *j*<sup>1</sup> openings through which the filtered material is extracted.

Fourth. Apparatus for acting continuously to separate water from slurry for cement manufacture or materials employed in the manufacture of cement consists of a perforated tube or vessel, preferably taper, covered on the inside with filter cloth or its equivalent and with an inner protecting screen such as wire gauze.

In practice we find wire gauze if sufficiently fine and after becoming coated with semi dry slurry to partially act as a filter cloth. At the smaller end of the tube or vessel, should such be taper, is a discharging opening.

The slurry is forced by pressure into the larger end of the tube or vessel, if made taper. The water passes through the filter cloth, and the partly dried materials flow continuously through the discharge opening. The perforated tube or vessel forming the continuous filter may be worked in vertical, horizontal, or other convenient position. When vertical the semi dry slurry is preferably discharged from the side at the bottom. The outflowing semi dry materials are by preference consolidated and formed into bricks or pieces. The exit of the filter is made of suitable form having a guillotine or other cutter to cut off lengths like bricks. If desired the bricks or pieces may be further consolidated before or after drying by subjection to further pressure in a brick or other machine. Final drying is effected by passing the bricks through an oven, the bricks being laid or piled on an endless travelling band of metallic plates.

Fig. 3 is a longitudinal section of apparatus under the above fourth part. *k* perforated taper tube clothed with filter cloth *l* and having an inlet for the liquid to be filtered at *m*, and an outlet for the filtered material at *n*. *o* represents a reciprocating blade for cutting the filtered material as it issues at *n* into lengths. *p* is a travelling band for conveying the filtered material to a travelling band oven of any usual construction.

Fifth. For drying filtered slurry and obtaining it in powder or small pieces for use in revolving calcining furnace we employ apparatus constructed mainly of brick with shelves of iron brick or other suitable material.

The shelves when made of metal are covered on the underside with fire clay or brick to prevent excessive heating.

In the centre of the said chamber is a placed a vertical shaft which passes through a hole in each shelf. Around the hole in each alternate shelf is cast or affixed raised pieces or rings to prevent any slurry or damp materials from falling directly down the chamber without passing over the shelves. On the shaft between the shelves we affix arms to carry suitable scrapers, ploughs, or rakes preferably made of steel fixed rigidly, weighted or with springs or their equivalents to enable the scrapers rakes ploughs or their equivalents to detach the dried materials without danger of breaking the said scrapers. We cause the said shaft and scrapers or the like to rotate.

The slurry enters the apparatus at the top and is constantly moved and allowed to fall from one shelf to another and in its downward passage meets ascending hot products of combustion. The dried and heated powdery slurry is conveyed, preferably whilst hot and by mechanical means to a suitable revolver and roasted into cement. The waste products of combustion from the manufacture of cement are preferably employed for drying the slurry and excess of oxygen is avoided so far as practicable when it is desired to eliminate free sulphur from the slurry.



British

*Hargreaves, Robinson, & Hargreaves' Improvements in the Manufacture of Cement, &c.*

Fig. 4 is a vertical section of part of apparatus under the fifth part, *g* are walls of a tower or furnace provided with iron shelves *r*. *r*<sup>1</sup> protected below by fire clay or like material *s*, *t* central shaft provided with arms *u*. *v* *v*<sup>1</sup> central and circumferential openings through the shelves *r*, *w* lips or rings to prevent slurry from passing through the central openings of the shelves *r*. The arms *u* have scrapers or rakes attached to them in any usual way to scrape the slurry alternately from the centre to the circumference, and from the circumference to the centre of the shelves. 5

Sixth. To rapidly "weather" that is carbonate and hydrate cement we subject the cement in a finely divided condition to the action of an artificial atmosphere of carbonic acid or carbonic acid and aqueous vapour. 10

Seventh. Apparatus for carrying the above treatment (sixth) into effect consists of a chamber formed of a series of shelves in which by mechanical means the cement is constantly stirred and fresh surfaces exposed as it falls from shelf to shelf to the said ascending carbonic acid or carbonic acid and aqueous vapour. Apparatus of the form described under the fifth head may be used and can be constructed of iron there being 15 no necessity to provide arrangements to prevent radiation or overheating of the iron.

Dilute carbonic acid such as cool products of combustion free from soot mixed with steam or aqueous vapour may be passed through the chamber for the purpose of carbonating and hydrating the cement. A convenient method of separating soot and supplying aqueous vapour to products of combustion is to pass flue gases through a wet scrubber before entering the "weathering" apparatus. 20

Apparatus under the seventh part is of similar construction to that shown in fig. 4, or of the usual tower and shelf construction for acting on solids by gases.

Having now particularly described and ascertained the nature of the said invention, and in what manner the same is to be performed, we declare that what 25 we claim is:—

First. Intimately mixing lime and clay by means of aeriform fluids in the manner and for the purpose substantially as described under the first part.

Second. Apparatus for carrying into effect the intimate mixing of lime and clay substantially as described under the first and second parts. 30

Third. Filtering apparatus constructed substantially as and for the purpose described under the third head.

Fourth. The continuous filter constructed substantially as and for the purpose set forth under the fourth part.

Fifth. With the continuous filter the means and appliances for conveying and drying 35 bricks or pieces of semi dry slurry in a heated chamber substantially in the manner and for the purpose set forth under the fourth part.

Sixth. The drying chamber in which slurry is dried by means of products of combustion brought in contact with the slurry as it is by mechanical means, moved upon and caused to fall from one shelf to another substantially as set forth under the 40 fifth head.

Seventh. The drying chamber with shelves rotating shaft and arms for the purpose set forth under the fifth head.

Eighth. "Weathering" cement by means of an artificial atmosphere of carbonic acid or carbonic acid and aqueous vapour substantially as set forth under the sixth 45 head.

Ninth. The apparatus substantially as described under the seventh head for the purpose set forth.

Dated this 14th day of November 1889.

Per pro J. T. KING, 50  
J. Johnson,  
Agent